CUSHIONED CARPET, CARPET TILE, AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Patent Application Serial No. 09/499,830, filed February 8, 2000, which is a continuation of U.S. Patent Application Serial No. 08/743,376 filed on November 4, 1996, which is a continuation of U.S. Patent Application Serial No. 08/468,707, filed on June 6, 1995, which is a division of U.S. Patent Application Serial No. 08/205,834, filed on March 3, 1994.

This application is also a continuation-in-part of U.S. Patent Application Serial No. 09/587,654, entitled **Low Weight Cushioned Carpet, Carpet Tile and Method** bearing a filing date of June 5, 2000.

FIELD OF THE INVENTION

The present invention relates to composites or constructions for surface coverings such as wall coverings or floor coverings including carpet, carpet tile, or the like, and more particularly, to a construction for a cushioned carpet or carpet tile incorporating recycled cushion material such as rebond foam. Processes and apparatus for forming the cushion backed composites or constructions of the present invention are also provided.

BACKGROUND OF THE INVENTION

As described in U. S. Patent Nos. 4,522,857, 5,540,968, 5,545,276, and 5,948,500 (all hereby incorporated by reference herein) carpet and carpet tiles having cushioned backings are well known to those of skill in the art. As described in U. S. Patent No. 5,948,500 and as shown herein, an example of a tufted carpet product 10A is illustrated in FIG. 1A and an example of a bonded carpet product 10B is illustrated in FIG. 1B.

In the tufted carpet 10A of Figure 1A, a primary carpet fabric 12 is embedded in an adhesive layer 16 in which is embedded a layer of glass scrim 18. A foam base composite 19 is likewise adhesively bonded to the adhesive layer 16. In such tufted carpet construction, the primary carpet fabric 12 includes a loop pile layer 20 tufted through a primary backing 22 such as a non-woven textile by a conventional tufting process and held in place by a pre-coat backing layer of latex 24 or other appropriate adhesive. The foam base composite 19 of the tufted carpet product 10A includes an intermediate layer 26 molded to a layer of urethane foam 28 as illustrated.

The bonded carpet product 10B of FIG. 1B employs the same type of foam base composite 19 adhesively bonded by adhesive laminate layers 16 in which is disposed a layer of glass scrim 18. However, the primary bonded carpet fabric 12 has somewhat different components from that of the tufted product 10B in that it has cut pile yarns 34 implanted in an adhesive such as PVC, latex, or hot melt adhesive 36 and has a woven or non-woven reinforcement or substrate layer 38 of material such as fiberglass, nylon, polypropylene, or polyester.

The formation of a foam base composite 19 for use in prior cushioned carpeting constructions of either tufted or bonded configuration has typically involved pre-forming and curing urethane foam across a carrier or backing material by practices such as are disclosed in U.S. Patent Nos. 4,171,395, 4,132,817, and 4,512,831 to Tillotson (all hereby incorporated by reference herein). As described in these patents, such a foam base composite may be laminated to a carpet base thereby yielding a cushioned structure.

As described in the above-mentioned 5,948,500 patent, the cost associated with such modular formation and assembly practices may be reduced by a simplified operation in which a primary carpet fabric, either with or without a stabilizing layer of scrim or the like, is laid directly into a polyurethane-forming composition and thereafter curing the polyurethane. The process can be made even more efficient if the polyurethane-forming composition requires no pre-curing prior to joining the carpet base.

Prior to the invention described in the 5,948,500 patent, the known processes directed to the application of the polyurethane cushioned backings to fabric substrates relied on the extremely close control of temperature in both the polyurethane composition and the adjoined fabric layer to effect stability through pre-cure of the polyurethane prior to lamination of the primary carpet to form a composite structure. Such pre-cure had been largely considered necessary in order to yield a stable foam structure to which the primary carpet backing could be applied. The application of heat to the polyurethane composition prior to joiner of the heated fabric backing caused polymer cross linking which had been thought to be necessary to stabilize the foam mixture to a sufficient degree to prevent the

collapse of the foam.

The invention described in the 5,948,500 patent also provides a particularly simple composite structure amendable to in-situ formation of a stable cushion carpet composite which is not believed to have been previously utilized. Specifically, it had not been previously recognized that a single process could be used to bring all the layers of the cushioned carpet composite together by laying a primary carpet fabric, either with or without some degree of preheat, directly into a mechanically frothed polyurethane-forming composition prior to curing the polyurethane and without an intermediate layer of material.

As indicated, the prior art carpet forming processes typically required the separate formation of a foam base composite having a backing layer and a layer of urethane foam. The backing layer is then used as an intermediate layer to which a primary carpet fabric and reinforcing layer can be adhesively bonded.

As described in the 5,948,500 patent, the base of the primary carpet fabric is adhesively bonded to a layer of non-woven glass reinforcement material to form a preliminary composite. A puddle of polyurethane-forming composition is simultaneously deposited across a woven or non-woven backing material. The preliminary composite and the polyurethane-forming composition are thereafter almost immediately brought together with the preliminary composite being laid into, and supported by, the polyurethane-forming puddle. The entire structure is then heated to cure the polyurethane forming composition. The preliminary composite may be slightly heated to about 120 degree F to improve

heating efficiency although the process may likewise be carried out without such preheating.

A superior cushion backed carpet tile or modular cushion back carpet tile on the market today, for example, sold under the trademark Comfort Plus® by Milliken & Company of LaGrange, Georgia has a primary carpet fabric with a face weight of about 20 to 40 oz/yd², a hot melt layer of about 38 to 54 oz/yd², a cushion of about 0.10 to 0.2 inches thick, a weight of about 28-34 oz/yd², and having a density of about 18 lbs. per cubic foot, and an overall product height of about 0.4 – 0.8 inches. This superior cushion back carpet tile provides excellent resilience and under foot comfort, exhibits performance characteristics that rate it for very heavy commercial use, and has achieved a notable status throughout the industry as having excellent look, feel, wear, comfort, and cushion characteristics, performance, properties, and the like. Such a superior cushion backed carpet tile is relatively expensive to produce due to the high quality and quantity of materials utilized.

Although attempts have been made at reducing the cost of floor coverings or carpet by using lower quality materials, such attempts have not been particularly successful. Low quality products tend to have a less than desirable look, feel, wear, comfort, cushion, and the like. Hence, such products have not been accepted in the industry and have failed commercially.

One successful process for producing a relatively low cost floor covering, carpet, or carpet tile is described in above-mentioned U.S. Patent Application Serial No. 09/587,654 (hereby incorporated by reference). The 09/587,654 application describes a process for

producing a low weight composite structure amenable to in-situ formation as a stable cushion carpet composite. One embodiment of such a low weight cushion carpet composite incorporates a low face weight primary carpet fabric of either tufted or bonded construction which is adhesively bonded to a layer of reinforcement material to form a preliminary composite. This preliminary composite is thereafter laid into a puddle of polyurethane–forming material. The resulting structure is then heated to cure the polyurethane-forming material thereby yielding a cushioned structure.

SUMMARY OF THE PRESENT INVENTION

The present invention provides advantages and alternatives over previous carpet constructions by providing a relatively low cost yet stable and durable layered cushioned composite which incorporates a layer of cushioning material incorporating recycled foam or rebond foam. The carpet construction of the present invention is thus equally suitable for manufacture by a wide variety of techniques including lamination of a preformed pre-cured layer of foam material, lamination of a preformed primary carpet and a performed foam layer or by an in-line application process. It is contemplated that a layer or layers of resilient adhesive material may either be substantially discrete from one another or may be intermixed across a layer of stabilizing material if such stabilizing material is sufficiently porous. Accordingly, by the term "layers" is meant both such discrete and intermixed masses. The construction of the present invention is thus characterized by substantial versatility in that it may be manufactured by both simple and more sophisticated manufacturing techniques.

In view of the foregoing it is a general object of the present invention to provide a cushion

backed surface covering, floor covering, flooring material, carpet, or carpet tile having a cushion formed of recycled cushion material or rebond foam.

It is a further object of the present invention to provide a cushioned carpet or carpet tile having a low face weight.

It is another object of the present invention to provide a carpet tile having a carpet with a face weight of less than or equal to about 15 oz/yd^2.

It is another object of the present invention to provide a carpet tile having a resilient or hot melt layer of less than or equal to about 50 oz/yd^2.

It is yet another object of the present invention to provide a carpet tile having a lightweight cushion.

It is a further object of the present invention to provide a carpet tile having a lightweight cushion of about 0.04 to 0.12 inches thick, preferably 0.04 – 0.09 inches thick.

It is still another object of the present invention to provide a carpet tile having a rebond cushion with a density of less than or equal to about 22 lbs. per cubic foot.

It is yet another object of the present invention to provide a carpet tile having a rebond cushion with a density of about 4 - 22 lbs. per cubic foot.

It is a further object of the present invention to provide a carpet tile having a light weight cushion with a weight of less than or equal to about 26 oz/yd^2.

It is a further object of the present invention to provide a modular carpet tile having resilience and under foot comfort.

It is still another object of the present invention to provide a modular carpet tile exhibiting performance characteristics that rate it for heavy commercial use.

It is a further object of the present invention to provide a method of forming flooring, carpet, carpet composite, carpet tile, or the like.

It is another object of the present invention to provide a method of forming a modular carpet tile having resilience, under foot comfort, and performance characteristics that rate it for heavy commercial use.

It is an object of the present invention to provide a cushioned carpet composite or tile wherein a reinforcement layer is disposed in or below a primary carpet.

It is a related object of the present invention to provide a cushioned carpet composite or tile wherein a primary carpet fabric is joined to a reinforcement layer and a cushion backing.

It is a further object of the present invention to provide a process for the formation of a

cushioned carpet composite or tile wherein a reinforcement layer is adhered to the base of a primary carpet fabric, a polyurethane cushion material has a non-woven backing layer, and the primary carpet fabric with the adhered reinforcement layer is attached to the polyurethane cushion material to form the carpet composite.

It is still a further related object of the present invention to provide a continuous process for the formation of a cushioned carpet composite wherein a reinforcement layer is adhered between a primary carpet base and a backing layer through the in-situ application of a hot melt or adhesive.

It is still a further related object of the present invention to provide an apparatus for carrying out the continuous formation of a cushioned carpet composite.

It is yet another object that the carpet composite and carpet tile of the present invention may be printed with orientation independent designs or designs having the ability to seam properly without cutting the tiles in register with the design and to allow the carpet to be installed monolithically as well as by conventional quarter turn "Parquet", or by ashler (brick). The preferred installation techniques are monolithic or ashler with or without floor adhesives.

In accordance with an exemplary embodiment of the present invention, a modular carpet composite which may be cut to form modular carpet tiles includes a low weight primary carpet or greige carpet having, for example, a face weight of less than or equal to about 15 oz/yd^2, a hot melt layer of less than or equal to about 50 oz/yd^2, and a lightweight cushion

of about 0.04 – 0.12 inches thick. The cushion may have a density of about 22 lbs. per cubic foot or less.

It is still another object to provide a modular carpet composite or modular carpet tile incorporating recycled foam or rebond foam and having unexpectedly excellent look, wear, cushion, resilience, under foot comfort, and performance characteristics that rate it for heavy commercial use. Hence, such a carpet composite or carpet tile may be used in place of standard cushion backed or hard backed carpet tile, or broadloom thus reducing cost, reducing material requirements, reducing weight, reducing energy requirements, reducing environmental impact, and the like.

In accordance with a particular example of the present invention, a modular carpet composite, for example 6 feet or 12 feet wide, is cut into modular carpet tiles or carpet squares, for example, 18 inches X 18 inches, 36 inches X 36 inches, 50 cm X 50 cm, 1 meter X 1 meter, 48 inches X 48 inches, or the like.

Also, the carpet composite or carpet tile of the present invention may be installed on site or on flooring by all of the conventional installation techniques as well as can be constructed for adhesive-free installation, self-stick, or the like.

Also, the carpet composite and carpet tile of the present invention may be printed with orientation independent designs or designs having the ability to seam properly without cutting the tiles in register with the design and to allow the carpet to be installed monolithically as well as by conventional quarter turn "Parquet", or by ashler (brick). The

preferred installation techniques are monolithic or ashler with or without floor adhesives.

In accordance with the present invention, it has been unexpectedly discovered that a carpet composite or carpet tile having excellent look, feel, wear, resilience, and under foot comfort and exhibiting performance characteristics that rate it for heavy commercial use can be formed by combining a primary carpet with a hot melt or resilient layer and a rebond cushion.

In accordance with the present invention, a low weight modular carpet tile is provided having an overall height of about 0.20 to 0.5 inches thick depending on the construction of the carpet tile (the number of layers or components) and which can be cut in any conventional shape or size.

The carpet composite of the present invention is especially adapted to be cut for use as modular carpet tiles, but also finds applicability as other carpet or flooring, such as, carpet, broadloom, area rugs, runners, floor mats, or the like.

It is a feature of the present invention to provide a, cushioned carpet composite or carpet tile including a primary carpet fabric in laminar relation to a reinforcement layer wherein such reinforcement layer is at least partially embedded in a polyurethane foam layer which is disposed adjacent to a non-woven backing layer. The reinforcement layer may be bonded to the base of the primary carpet fabric by the polyurethane foam or by a separate adhesive.

It is a feature of the present invention to provide a, cushioned carpet composite or carpet tile including a primary carpet fabric in laminar relation to a polyurethane foam layer which is disposed adjacent to a non-woven backing layer.

It is a feature of the present invention to provide a cushioned carpet composite or carpet tile including a primary carpet fabric in laminar relation to a reinforcement layer and a polyurethane foam layer. The reinforcement layer may be bonded to the base of the primary carpet fabric by the polyurethane foam or by a separate adhesive.

It is a further feature of the present invention to provide a process for forming a cushioned carpet composite including the simultaneous continuous steps of adhering a woven or non-woven reinforcement material to the base of a primary carpet fabric and to the upper surface of a cushion layer.

It is a further feature of the present invention to provide a process for forming a cushioned carpet composite including the steps of adhering a woven or non-woven reinforcement material to the base of a primary carpet fabric and adhering a rebond polyurethane foam and backing layer to the reinforcement material.

It is a further feature of the present invention to provide a process for forming a cushioned carpet composite including the steps of forming a primary carpet fabric; forming a rebond polyurethane foam layer, and adhering the primary carpet fabric to the rebond polyurethane foam layer.

It is yet a further feature of the present invention to provide an apparatus for use in the continuous in line formation of a cushioned carpet composite wherein the apparatus includes an adhesive application apparatus for adhering a reinforcement layer to the base of a primary carpet fabric and the upper surface of a foam layer.

It is yet a further feature of the present invention to provide an apparatus for use in the formation of a cushioned carpet composite wherein the apparatus includes a polymer application unit for depositing a polyurethane-forming composition or other suitable polymer to the base of a primary carpet fabric and the upper surface of a foam or cushion layer.

It is yet a further feature of the present invention to provide an apparatus for use in the formation of a cushioned carpet composite wherein the apparatus includes an adhesive application apparatus for adhering a reinforcement layer to the base of a primary carpet fabric.

In accordance with one aspect of the present invention, a cushioned carpet, composite, or tile is provided. The cushioned carpet includes a primary carpet having a primary base and a plurality of pile-forming yarns projecting outwardly from one side. A layer of reinforcement material is bonded to the primary base on the side away from the pile-forming yarns. The reinforcement material is adjacent to, and attached to a cushion layer of polymer such as polyurethane. An optional backing material is preferably disposed on the underside of the cushion layer. The backing material may include an adhesive backing on the side away from the cushion layer.

In accordance with one aspect of the present invention, a cushioned carpet, composite, or tile is provided. The cushioned carpet includes a primary carpet having a primary base and a plurality of pile-forming yarns projecting outwardly from one side. A layer of reinforcement material is bonded to the primary base on the side away from the pile-forming yarns. The reinforcement material is adjacent to a cushion layer of polymer such as rebond polyurethane. An optional backing material is preferably disposed on the underside of the cushion layer. The backing material may include an adhesive backing on the side away from the cushion layer.

In accordance with one aspect of the present invention, a cushioned carpet, composite, or tile is provided. The cushioned carpet includes a primary carpet having a primary base and a plurality of pile-forming yarns projecting outwardly from one side. A cushion layer is bonded to the primary base on the side away from the pile-forming yarns. A reinforcement material may be embedded in the cushion layer of polymer such as two layers of rebond polyurethane. The cushion layer may be bonded to the primary carpet by a layer of hot melt. An optional backing material is preferably disposed on the underside of the cushion layer. The backing material may include an adhesive backing on the side away from the cushion layer.

In accordance with another aspect of the present invention, a process for making a cushioned carpet is provided. The process involves obtaining a primary carpet fabric comprising a plurality of pile-forming yarns extending outwardly from one side of a primary base. A layer of reinforcement material is adhered to the primary carpet fabric on the side,

from which the pile-forming yarns do not extend, thereby forming a preliminary composite. The preliminary composite is then adhered to a cushion layer. Following this mating operation, the carpet is cut to size or into tiles.

In accordance with another aspect of the present invention, a process for making a cushioned carpet is provided. The process involves obtaining a primary carpet fabric comprising a plurality of pile-forming yarns extending outwardly from one side of a primary base. The primary carpet fabric is then attached to a cushion layer. Following this mating operation, the composite is preferably heat cured and then the carpet is cut into tiles.

In accordance with another aspect of the present invention, a process for making a cushioned carpet is provided. The process involves obtaining a primary carpet fabric comprising a plurality of pile-forming yarns extending outwardly from one side of a primary base. A layer of reinforcement material is adhered to the primary carpet fabric on the side, from which the pile-forming yarns do not extend, thereby forming a preliminary composite. The preliminary composite is then attached to a rebond cushion layer. Following this mating operation the composite is preferably heat cured and then the carpet is cut into tiles.

In accordance with still another aspect of the present invention, an apparatus for use in forming a cushioned carpet composite is provided, comprising: a reinforcement bonding unit for bonding a layer of reinforcement material to the underside of a primary carpet fabric to form a preliminary carpet composite; a mating unit for mating said preliminary carpet composite to a cushion layer; and means for heat curing the final composite;

wherein said reinforcement bonding unit, said mating unit, and said heat curing means are operable in a continuous, simultaneous manner.

In accordance with still another aspect of the present invention, an apparatus for use in forming a cushioned carpet composite is provided, comprising: a reinforcement bonding unit for bonding a layer of reinforcement material to the underside of a primary carpet fabric to form a preliminary carpet composite; a polymer application unit for dispersing a polyurethane-forming composition across the surface of a cushion layer; means for heat curing the polyurethane-forming composition to said preliminary carpet composite, and a mating unit for joining the carpet composite and cushion layer.

In accordance with still another aspect of the present invention, an apparatus for use in forming a cushioned carpet composite is provided, comprising: a reinforcement bonding unit for bonding a layer of reinforcement material to the underside of a primary carpet fabric and to the top side of a cushion layer to form a carpet composite.

In accordance with another embodiment of the present invention, a modular carpet tile is manufactured by:

tufting broadloom at a weight of 45 oz/yd^2 or less,

printing a design in broadloom form,

applying a rebond cushion backing system, and

cutting into square tiles.

The modular carpet tile of the present invention is aesthetically pleasing and exhibits

performance characteristics that rate it for a heavy commercial application. The combination of a carpet fabric, hot melt layer, and cushion backing also provides resilience and under-foot comfort.

The carpet, composite, and tile of the present invention is especially suited for broadloom because of:

a. Tufted design

b. Applied design

c. Attached rebond cushion backing

It is a feature of the present invention to provide a composite cushioned carpet or tile wherein a reinforcement layer is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and above a cushion layer such that at least a portion of the polymeric adhesive is disposed on and extends away from either side of the reinforcement layer.

According to one aspect of the present invention, a construction of a cushioned carpet composite is provided wherein a reinforcement layer is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and adjacent the upper surface of a foam layer such that the polymeric adhesive bonds the primary carpet to the foam layer with the reinforcement layer disposed at an intermediate position between the primary carpet and the foam layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of glass is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the material forming the polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of textile material is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the material forming the polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite or tile is provided wherein a reinforcement layer of scrim construction is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of textile scrim material is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of glass scrim material is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of non-woven construction is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of non-woven glass is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of non-woven textile material is disposed intermediate discrete or intermixed layers of resilient polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the material forming the polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of glass is disposed intermediate discrete or intermixed layers of resilient hot melt polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the hot melt polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of textile material is disposed intermediate discrete or intermixed layers of resilient hot melt polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the hot melt polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of glass is disposed intermediate discrete or intermixed layers of resilient thermosetting polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the thermosetting polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a cushioned carpet composite is provided wherein a reinforcement layer of textile material is disposed intermediate discrete or intermixed layers of resilient thermosetting polymeric adhesive below a primary carpet and above a foam layer such that at least a portion of the thermosetting polymeric adhesive is disposed on either side of the reinforcement layer.

According to another aspect of the present invention a process is provided to form a cushioned carpet composite wherein a reinforcement layer is attached below a primary carpet such that a resilient polymeric adhesive is disposed in sandwiching relation on either side of the reinforcement layer so as to form an adhesive bonding surface below the reinforcement layer and adhesively bonding a preformed foam or rebond layer below the polymeric adhesive. An optional backing material or multi-component backing composite may be disposed on the underside of the cushion or foam layer.

According to another aspect of the present invention a lamination process is provided to form a cushioned carpet composite wherein a reinforcement layer is attached below a primary carpet such that a resilient polymeric adhesive is disposed in sandwiching relation on either side of the reinforcement layer so as to form an adhesive bonding surface below the reinforcement layer and adhesively bonding a preformed foam layer below the polymeric adhesive. An optional backing material or multi-component backing composite may be disposed on the underside of the cushion layer.

According to another aspect of the present invention an in line process is provided to form a cushioned carpet composite wherein a reinforcement layer is attached below a primary carpet such that a resilient polymeric adhesive is disposed in sandwiching relation on either side of the reinforcement layer so as to form an adhesive bonding surface below the reinforcement layer and adhesively bonding a preformed foam layer below the polymeric adhesive. An optional backing material or multi-component backing composite may be disposed on the underside of the cushion layer.

In accordance with an exemplary embodiment of the present invention, a cushioned carpet composite or tile is provided wherein a reinforcement layer of non-woven glass is disposed between layers of a hot melt polymeric adhesive below a primary carpet and above a foam layer such that the hot melt polymeric adhesive extends in joining relation between the primary carpet and one side of the foam layer with the reinforcement layer being held within the hot melt polymeric adhesive at a position between the foam layer and the primary carpet such that at least a portion of the hot melt polymeric adhesive extends away from either side of the reinforcement layer. An optional backing material or multi-component backing composite may be disposed on the underside of the cushion layer.

In accordance with one embodiment of the present invention, a preformed "rebond" foam, pad or underlayment is used to manufacture a commercial grade cushion carpet tile. A rebond pad of approximately 13 pounds/cubic foot density is modified to have a respective non-woven material bonded to each of the upper and lower surfaces thereof. The composite rebond pad has a thickness of approximately .25" and is slit in half, producing two foam backings, each approximately .125" thick with a non-woven material attached to one surface. Next, the slit pad is directly bonded using a hotmelt adhesive to either pre-coated tufted carpet or latex based bonded carpet and then cut into tiles.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the present invention will now be presented with reference to the accompanying drawings which are incorporated in and which constitute a part of this specification and in which:

FIG. 1A is a cut-away side view of a tufted carpet with a cushioned composite structure;

FIG. 1B is a cut-away side view of a bonded carpet incorporating a cushioned composite structure;

FIG. 2 is a schematic process diagram illustrating an assembly process for forming a carpet construction according to the one embodiment present invention;

FIG. 3A is a cut-away side view of a carpet construction according to the present invention incorporating a tufted primary carpet surface;

FIG. 3B is a cut-away side view of a carpet construction according to the present invention incorporating a cut loop tufted primary carpet surface;

FIG. 3C is a cut-away side view of a carpet construction according to the present invention incorporating a bonded primary carpet surface;

FIG. 4 is a schematic process diagram illustrating an assembly process for forming a carpet construction according to another embodiment of the present invention;

FIG. 5 is a schematic of a process line for assembly of a carpet construction according to still another embodiment of the present invention;

FIG. 5A is a schematic of a process line for assembly of a carpet construction according to yet another embodiment of the present invention;

FIG. 5B is a view similar to FIG. 5, illustrating an alternative process line for assembly of a carpet construction according to still yet another embodiment of the present invention;

FIG. 6A is a cut-away side view of an alternative embodiment of a tufted carpet having no separate adhesive pre-coat;

FIG. 6B is a cut-away side view of an alternative embodiment of a tufted carpet having no separate adhesive pre-coat;

FIG. 7A is a cut-away side view of an alternative embodiment of a tufted carpet having a reinforcement layer disposed between two different adhesive layers;

FIG. 7B is a cut-away side view of an alternative embodiment of a tufted carpet having a reinforcement layer disposed between two different adhesive layers;

FIG. 7C is a cut-away side view of an alternative embodiment of a bonded carpet having a reinforcement layer disposed between two different adhesive layers;

FIG. 8A is a cut –away side view of an alternative embodiment of a tufted carpet having a reinforcement layer disposed between two layers of latex adhesive;

FIG. 8B is a cut –away side view of an alternative embodiment of a tufted carpet having a reinforcement layer disposed between two layers of latex adhesive;

FIG. 9A is a cut –away side view of an alternative embodiment of a tufted carpet having glass reinforcement disposed across the underside of the primary backing;

FIG. 9B is a cut –away side view of an alternative embodiment of a tufted carpet having glass reinforcement disposed across the underside of the primary backing;

FIG. 10A is a cut-away side view of an alternative embodiment of a tufted carpet including a multi-component backing composite;

FIG. 10B is a cut-away side view of an alternative embodiment of a tufted carpet including a multi-component backing composite;

FIG. 10C is a cut-away side view of an alternative embodiment of a bonded carpet including a multi-component backing composite;

FIG. 11A is a cut-away side view of an alternative embodiment of a tufted carpet including a foam cushion with no backing;

FIG. 11B is a cut-away side view of an alternative embodiment of a tufted carpet including a foam cushion with no backing;

FIG. 11C is a cut-away side view of an alternative embodiment of a bonded carpet including a foam cushion with no backing;

FIG. 12A is a cut-away side view of an alternative embodiment of a tufted carpet including a foam cushion with a releasable adhesive backing;

FIG. 12B is a cut-away side view of an alternative embodiment of a tufted carpet including a foam cushion with a releasable adhesive backing;

FIG. 12C is a cut-away side view of an alternative embodiment of a bonded carpet including a foam cushion with a releasable adhesive backing;

FIG. 13A is a cut-away side view of an alternative embodiment of a tufted carpet including a multi-component composite backing including a releasable adhesive underside;

FIG. 13B is a cut-away side view of an alternative embodiment of a tufted carpet including a multi-component composite backing including a releasable adhesive underside; and

FIG. 13C is a cut-away side view of an alternative embodiment of a bonded carpet including a multi-component composite backing including a releasable adhesive underside;

FIG. 14A is a cut-away view of a tufted carpet with a cushioned composite structure.

FIG. 14B is a cut-away side view of a bonded carpet incorporating a cushioned composite structure.

FIG. 15A is a cut-away side view of a tufted carpet incorporating a structure formed by the apparatus and process of the present invention.

FIG. 15B is a cut-away side view of a bonded carpet incorporating a structure formed by the apparatus and process of the present invention.

FIG. 16A is a cut-away side view of an alternative embodiment of a tufted carpet having no reinforcement layer.

FIG. 16B is a cut-away side view of an alternative embodiment of a bonded carpet having no reinforcement layer.

FIG. 17A is a cut-away side view of an alternative structure for a tufted carpet.

FIG. 17B is a cut-away side view of an alternative structure for a bonded carpet.

Figures 18A and 18B are respective simple and more complex schematic flow diagrams of the production of modular carpet tiles in accordance with selected embodiments of the present invention.

Figures 19 – 27 are schematic construction or layer diagrams of respective tufted and

bonded carpet, composite, or tiles in accordance with different embodiments or aspects of the present invention.

Although Figures 19A and 20-27 show a looped pile in the primary carpet and Figure 19B shows a bonded primary carpet, it is to be understood that a tufted or bonded looped and/or cut pile may be used and that the pile may be sculptured, printed, dyed, and/or the like as desired.

While the invention has been illustrated and will hereinafter be described and disclosed in connection with certain preferred embodiments, practices and procedures, it is by no means intended to limit the invention to such specific embodiments, practices and procedures. Rather it is intended to cover all such alternatives and modifications thereto as may fall within the true spirit and scope of the invention and all equivalents thereto as defined and limited only by the claims appended hereto.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In accordance with the present invention, a cushioned composite construction suitable for use in covering products such as wall coverings and floor covering products including broadloom carpeting and modular carpet tile is provided. Referring to FIGS 2, 3A, 3B and 3C simultaneously, a basic assembly procedure of components within a carpet construction according to the present invention is provided. As illustrated, according to a potentially preferred embodiment, the tufted and bonded carpet constructions 110A, 110B, 110C of the present invention incorporate a layered arrangement of a pile forming primary carpet fabric 112 in overlying relation to a sheet of reinforcement material 158, which in

turn is disposed in overlying relation to a layer of cushioning foam or rebond foam 178 which may include an optional backing layer 170 (FIGS. 3A, 3B, 3C) or multi-component backing composite (FIGS. 10A-C and 13A-C) as will be described further hereinafter. The optional backing layer 170 is preferably a woven or non-woven textile fabric of polyester, polypropylene or other appropriate fibers. A non-woven structure of about 80% polyester fiber and about 20% polypropylene fiber may be particularly preferred.

The sheet of reinforcement material 158 is preferably embedded between layers of polymeric adhesive 160 such as a hot melt adhesive or the like extending on either side of the sheet of reinforcement material 158 to establish a bonding relationship between the primary carpet fabric 112 and the cushioning foam or rebond 178. As previously indicated, such layers of adhesive 160 may be either substantially discrete with the reinforcement material 158 establishing a barrier between such layers or the layers of adhesive 160 may be at least partially intermixed across the reinforcement material 158. In either event, due to the intimate bonding relationship between the reinforcement material 158 and the layers of adhesive 160, the layers of adhesive 160 in combination with the reinforcement material forms a bridging composite of substantial stability extending between the cushioning foam or rebond foam 178 and the primary carpet fabric 112.

It is contemplated that the primary carpet fabric may incorporate either a tufted or a bonded configuration (with loop or cut pile) as described in relation to FIGS. 1A and 1B and FIGS. 3A, 3B, and 3C. It is also contemplated that the primary carpet may take on any number of other pile forming or non-pile forming constructions including by way of

example only and not limitation, flat or textured fabrics having woven, knit, or non-woven constructions.

According to one potentially preferred embodiment, the primary carpet fabric 112 preferably includes a plurality of pile-forming yarns projecting outwardly from one side of a primary base. If the primary carpet 112 used in the present invention is a tufted carpet as illustrated in FIGS. 3A and 3B, its configuration will preferably conform substantially to that of the primary carpet 12 illustrated in FIG. 1A, with the difference that the pile forming yarns 121 of the embodiment shown in FIG. 3B have undergone a tip shearing or loop cutting operation to yield a cut pile construction. If the primary carpet 112 used in the present invention is a bonded product as illustrated in FIG. 3C, its configuration will preferably be that of the bonded primary carpet 12 illustrated in FIG. 1B. It is contemplated that the primary carpet may include one or more backing or base layers.

It is to be understood that, as with the prior art products, wherein the primary tufted or bonded carpet fabric 12 may have different embodiments, the component structure of the primary carpet fabric is not critical to the present invention. Rather it is intended that any primary carpet fabric having a pile forming portion and a primary base or backing may be utilized as the primary carpet fabric. By "primary base" is meant any single layer or composite structure including, inter alia, the commonly used layered composite of primary backing 22 and latex pre-coat 24 previously described in relation to the tufted product (FIG. 1A) and the adhesive layer 36 with reinforcement substrate 38 previously described in relation to the bonded product (FIG. 1B). As will be appreciated, the use of polyester in the primary base structure may be desirable due to the eventual heat curing such structure

may undergo. Other embodiments as may occur to those of skill in the art may, of course, also be utilized. For example, in the bonded product, the pile forming yarns could be heat tacked to the substrate 38 as described in U. S. Patent No. 5,443,881 (hereby incorporated by reference herein) to permit simplified construction of a primary carpet.

Alternative embodiments including those disclosed in U.S. Pat. No. 4,576,665 to Machell (incorporated by reference) may likewise be utilized. For example, it is contemplated that specialized primary backings such as non-woven structures comprising fiberglass sandwiched between layers of polyester may be utilized in the primary tufted carpet to impart the desired properties relating to stability thereby potentially reducing or even eliminating the need for the secondary backing or the latex pre-coat presently utilized in the manner to be described further hereinafter. Moreover, it is contemplated that if a pre-coat is to be utilized, it may be added directly in-line in an operation prior to any adhesive bonding operation (FIG. 5A).

With regard to one embodiment, in the tufted carpet construction 110A of the present invention (FIG. 3A), the primary carpet fabric 112 preferably comprises a loop pile layer of pile-forming yarns 120 tufted into a primary backing 122 as is well known and held in place by a pre-coat layer 124 of a bonding material such as latex, a hot melt adhesive or a urethane based adhesive. It is contemplated that the pre-coat layer 124 may be applied to the primary backing 122 either in a preliminary processing step during formation of the primary carpet fabric 112 or may be added in-line during formation of the cushioned carpet construction in a manner to be described further hereinafter in reference to FIG. 5A. The primary carpet fabric 112 may be steamed and/or heated after addition of the pre-coat

layer 124 to facilitate subsequent printing operations, such as direct or indirect jet dying or printing, and/or if desired to reduce stresses.

The two basic primary backing constructions are woven polypropylene and non-woven polyester. Each material may have a variety of construction characteristics engineered for a specific end use. According to one potentially preferred embodiment, the preferred primary backing material 122 is 20 pick per inch, woven polypropylene, with needle punched nylon fleece.

With regard to another embodiment, in the cut pile tufted carpet construction 110B of the present invention (FIG. 3B), the primary carpet fabric 112 preferably comprises a loop pile layer of pile-forming yarns 120 tufted into a primary backing 122 as is well known and held in place by a pre-coat layer 124 of a bonding material such as latex, a hot melt adhesive or a urethane based adhesive. The pile forming yarns 120 are subjected to a tip shearing or loop cutting operation to yield the cut pile construction as shown. It is contemplated that the pre-coat layer may be applied to the primary backing 122 either in a preliminary processing step during formation of the primary carpet fabric 112 or may be added in-line during formation of the cushioned carpet construction in a manner to be described further hereinafter in reference to FIG. 5A. The primary carpet fabric 112 may be steamed and/or heated after addition of the pre-coat layer 124 to facilitate subsequent printing operations, such as direct or indirect jet dying or printing, and/or if desired to reduce stresses.

The two basic primary backing constructions are woven polypropylene and non-woven polyester. Each material may have a variety of construction characteristics engineered for

a specific end use. According to one potentially preferred embodiment, the preferred primary backing material 122 is 20 pick per inch, woven polypropylene, with needle punched nylon fleece.

In the bonded carpet construction 110C of the present invention (FIG. 3C), the primary carpet fabric 112 preferably comprises a plurality of cut pile yarns 134 implanted in a latex or hot melt adhesive 136 which is laminated to a reinforcement or substrate layer 138 of a woven or non-woven material including fiberglass, nylon, polyester or polypropylene. It is contemplated that this substrate layer 138 may be pre-coated with latex or other thermoplastic polymers to permit melting adhesion with the cut pile yarns 134 upon the application of heat, thereby potentially reducing or eliminating the need for the latex or hot melt adhesive 136.

The yarns 120, 121, 134 may be either spun or filament yarns and are preferably formed from a polyamide polymer such as nylon 6 staple, nylon 6 filament, or nylon 6,6 staple, nylon 6,6 filament, available from DuPont Fibers in Wilmington, Del., although other suitable natural or synthetic yarns may likewise be employed as will be recognized by those of skill in the art. By way of example only and not limitation, other materials, which might be used, include polyester staple or filament such as polyethylene terephthalate (PET), and polybutylene terephthalate (PBT); polyolefins, such as polyethylene and polypropylene staple or filament; rayon; and polyvinyl polymers such as polyacrylonitrile. A variety of deniers, plies, twist levels, air entanglement, and heatset characteristics can

be used to construct the yarn. One potentially preferred material is nylon 6,6, filament, 1360 denier, 1 ply, no twist, no entanglement, and no heatset.

According to one embodiment, the face weight of the yarn across the carpet will be less than about 20 ounces per square yard and will more preferably be not greater than about 15 ounces per square yard and will most preferably be not greater than about 12 ounces per square yard. It is believed that the use of no twist yarn of sufficient denier (in the range of about 1000d to 1400d) in non-heatset form may facilitate the achievement of plush coverage even at such relatively low face weights due to bulking which takes place during subsequent dying and steaming operations.

According to another embodiment, the face weight of the yarns across the carpet will be in the range of about 20 to about 40 ounces per square yard and will preferably be in the range of about 24 to 28 ounces per square yard.

In the tufted product, the adhesive pre-coat 124 is preferably styrene butadiene rubber (SBR) latex but other suitable materials such as polyvinyl chloride (PVC), ethylene vinyl acetate (EVA), acrylic, and hot melt adhesives as are well known to those of skill in the art may likewise be utilized. As will be described further hereinafter, in the event that a hot melt adhesive is utilized, it is contemplated that a reinforcement material such as a glass scrim or non-woven can be directly attached to form a composite laminate without the use

of additional adhesive layers. Moreover, it is contemplated that the adhesive pre-coat 124 may be entirely eliminated in the tufted product if the loop pile 120 is tufted in suitably stable relation to the primary backing 122 thereby yielding a composite structure as illustrated in FIGS. 6A and 6B.

It is contemplated that a carpet construction according to the present invention including either a tufted or a bonded pile forming primary carpet fabric 112 may be adjoined to an underlying sheet of reinforcement material 158 by layers of a resilient polymeric adhesive material 160. The polymeric adhesive material 160 may be of either a thermoplastic or a thermosetting composition. Hot melt materials may be particularly preferred. By way of example only and not limitation, useful hot melts may include bitumen, polyolefin-based thermoplastic, and polyurethanes. One potentially preferred hot melt material is polyolefin based thermoplastic. It is contemplated that the total mass of hot melt adhesive utilized within both layers adjacent the reinforcement material will preferably be in the range of about 20 to about 60 ounces per square yard of carpet and will more preferably be present at a level of about 35 to about 55 ounces per square yard of fabric.

The reinforcement material 158 serves to enhance dimensional stability across the carpet construction to substantially prevent the various layers from undergoing disproportionate dimensional change as the carpet construction is subjected to compressive forces during use and temperature changes during use or processing. The reinforcement material is preferably a sheet incorporating multiple glass fibers entangled in a non-woven construction. Such a construction is believed to provide substantially uniform load bearing characteristics in all directions, which may be beneficial in some instances. Other

materials as may be utilized include glass scrim materials as well as woven or non-woven textile materials such as polyester.

As illustrated in FIGS. 2, 3A, 3B and 3C, the polymeric adhesive material 160 is preferably disposed in covering relation on either side of the reinforcement material 158. It is contemplated that such an embedded relation may be achieved by any number of manual or automated techniques. By way of example only, and not limitation, one such technique as may be employed is the direct application of the adhesive material 160 to each side of the reinforcement material 158 preceding insertion between the layer of cushioning foam or rebond 178 and the primary carpet fabric 112. Of course it is contemplated that such application may be conducted by any appropriate means as may be known to those of skill in the art including by way of example only and not limitation, spray coating, dip coating, roll coating, or manual application. However, notwithstanding the actual application mechanism as may be utilized, it is contemplated that the adhesive material 160 will extend in covering relation away from each side of the reinforcement material 158. In this regard, it is contemplated that the adhesive material will preferably perform the dual functions of securing the reinforcement material 158 in place while simultaneously forming a bonding bridge between the underside of the primary carpet fabric 112 and the upper surface of the cushioning foam or rebond foam 178.

According to a simplified processing arrangement as illustrated in FIG. 2, a preformed layer of, for example, polyurethane cushioning foam or rebond foam 178 either with or without a backing layer 170 (FIGS. 3A and 3B) or a multi-component backing composite (FIGS. 10A-C) is conveyed along a travel path to a first mating calender 191 for joinder to,

for example, a non-woven sheet of glass tissue, reinforcement material 158 which has been covered on its underside with a lower coating of hot melt polymeric adhesive material 160 at a first coating station 192. An additional upper coating of hot melt polymeric adhesive 160 is thereafter applied across the upper surface of the reinforcement material 158 at a second coating station 193. Due to the high surface area and relatively porous nature of the non-woven reinforcement material, the polymeric adhesive 160 may extend at least partially through the reinforcement material while at the same time establishing a stable mechanical bond therewith. A preformed pile forming primary carpet fabric 112 as previously described is thereafter applied in overlying relation to the coated reinforcement material 158 at a second mating calender 194 such that the polymeric adhesive material 160 establishes a bond extending between the cushioning foam or rebond foam 178 and the underside of the primary carpet fabric 112. The resulting construction may be heated at 198 and is substantially as illustrated in FIGS. 3A, 3B or 3C.

As described in U.S. Patent Nos. 5,312,888; 5,817,703; 5,880,165; and 6,136,870 (hereby incorporated by reference) rebond foam or rebond polyurethane foam is known in the art of isocyanate-based polymeric foams. Specifically, it is known to mix pieces of foam with a binder which serves to bond the pieces to one another. Rebonding technology has been used for a number of years to recycle, inter alia, polyurethane foams. Generally, the rebonded polyurethane foam product has been used in broadloom carpet underlayment pad, and specific seating and cushioning applications. Given the prior applications for rebond foam, it is not surprising that these foams have not been used in cushion back carpet tile applications.

Polymer foams, particularly flexible polymer foams, can be fabricated into objects having useful shapes. For example, flexible foams can be molded or machined into shapes useful for preparing automobile seats, bedding, and the like. Flexible foams can be used in carpet and furniture production, as well as in the manufacture of toys and the like.

However, in processes for preparing shaped polymer foams, waste foam can be produced. The waste foam can be from the fabricating process and represent the area/volume of the foam removed from the starting block stock to form the shaped foam object. The waste foam can also be the trimmings, scrapes, or off-specification products which are occasionally produced in some fabricating processes.

Whatever its source, waste foam production is usually undesirable. The waste foam can represent materials which must be discarded and not sold. In some areas, landfill space has become scarce and the cost of disposing of waste foam has become very high.

There have been efforts to recycle or re-use waste foam production, particularly waste and scrap from the production of flexible foams. Flexible polyurethane foam scrap can be chopped or chipped and then coated with a binder consisting of a polyisocyanate prepolymer having isocyanate functionality, and a catalyst. The coated, chopped foam is compressed and then treated with steam to cure the binder to form a rebond foam sheet or other shape.

In another process for recycling or using flexible polyurethane foam waste, the flexible foam waste is cryogenically ground and blended back into the formulation used to prepare it. The ground flexible foam can be used at a level of about 20 percent within the polyol component of the polyurethane foam formulation.

In accordance with the present invention, it is preferred to use at least about 20-50% recycled foam or rebond foam containing at least about 20-50% recycled foam chips, chunks, pieces, grounds, or the like to produce a cushioned carpet composite or carpet tile having at least about 20-50% recycled foam or cushion content.

In accordance with the present invention, it is preferred to use a rebond foam having a backing, such as a woven or non-woven material on at least one surface.

In accordance with the present invention, it is preferred to use a rebond foam or polyurethane rebond foam with a density of about 1 to 25 lbs per cubic foot, more preferably about 3-22 lbs. per cubic foot, most preferably 10-13 lbs. per cubic foot, a thickness of about 2-20 mm, a rebond chip size of about 2-25 mm, more preferably about 5-15 mm, most preferably 7-10 mm round hole mesh, and a backing material or backing composite on at least one side thereof.

By way of another example, as illustrated in FIG. 4, it is contemplated that a preformed reinforcement material composite 159 including a pre-applied hot melt coating on one or both sides may be laminated to a preformed foam or rebond layer 178 and primary carpet

fabric 112 by heating the upper and lower surfaces of the composite 159 by heating elements 195 such as a flame 196 or the like and pressing the three preformed materials 112, 159, 178 together. If desired, heat may be applied to the resulting construction at 197.

As previously indicated, due to the relatively porous nature of the reinforcement material 158, it is contemplated that the hot melt adhesive may be pressed through such material. Thus, it is contemplated that the first coating station 192 in FIG. 2 may be replaced with a forced spray, roll or the like if desired to deposit hot melt adhesive 160 across both sides of the reinforcement material 158 prior to lamination.

While the carpet construction according to the present invention may be formed utilizing the eloquently simple assembly or lamination processes as illustrated and described above in relation to FIGS. 2 and 4, it is contemplated that a degree of efficiency may be realized by utilizing in-situ or in-line processes for formation thereof. Referring to FIG. 5, according to one exemplary process, a primary carpet fabric 112, with or without a pre-coat underlayer, is conveyed by means of a plurality of rolls through an accumulator 150 to a reinforcement bonding unit 155. Simultaneously with the conveyance of the primary carpet fabric 112 to the reinforcement bonding unit 155, a sheet of reinforcement material 158 is likewise conveyed to the reinforcement bonding unit 155. The reinforcement material 158 is preferably fiberglass non-woven material such as a 2.0 oz/yd^2 fiberglass containing a urea formaldehyde binder although alternative materials may include by way of example only, woven glass, woven polyester, non-woven glass, and non-woven polyester.

At the reinforcement bonding unit 155, an adhesive material 160 such as a hot melt polymeric adhesive is preferably applied to at least the top surface of the reinforcement material 158 by means of a film coater or other such unit as are well known. The coated reinforcement material 158 and the primary carpet fabric 112 are thereafter preferably passed in mating relation between joining members such as rolls 163, 165, thereby bonding the coated reinforcement material 158 to the underside of the primary carpet fabric 112. That is, the reinforcement material 158 is bonded on the side of the primary carpet fabric 112 from which the pile forming yarns do not project. The bonding of the reinforcement material 158 to the underside of the primary carpet fabric produces a preliminary composite 166 to the underside of which another coating of adhesive material 160 is applied at a coating station 179 to substantially enclose the reinforcement material 158 within such adhesive material and to form an intermediate composite 167 which is thereafter laid into an adhesive, hotmelt, or a polyurethane-forming composition layer 179 on top of a preformed foam or rebond layer 178 as described below.

Although the reinforcement bonding unit 155 is illustrated as incorporating a film coater, and the coating station 179 is illustrated as incorporating a vertical application roll, it is to be understood that any number of alternative means such as spray coaters, blade coaters, dip coaters, or the like may also be utilized. By way of example only, and not limitation several alternative means for the application of adhesive 160 are disclosed in U.S. Pat. No. 4,576,665 to Machell.

According to a potentially preferred practice, while the preliminary composite 166 is being formed, a preformed foam or rebond layer 178 is passed through a polymer application unit 175 which preferably includes a polymer discharge unit 176 and a doctor blade 177. The foam layer 178 is coated with an adhesive or polymer 179 such as a polyurethane-forming composition as disclosed more fully below.

In the preferred embodiment, the preformed foam layer 178 may include a backing material 170 such as woven or non-woven 10% to 100% polyester/polypropylene, preferably 50% polyester/ 50% polypropylene non-woven fibrous material or felt which is available from Spartan Mills Company in Spartanburg, S.C. While this represents the backing material of preference, it is to be understood that any number of alternative compositions or composites may likewise be utilized as dictated by requirements regarding shrinkage and installation. The commonly used secondary backing materials include non-woven polyester, non-woven polyester and polypropylene blends, or woven polypropylene. By way of example only, in instances where very little or no shrinkage may be tolerated, the backing material may be up to 100% polyester. Further, while a non-woven backing material may be preferred, it is contemplated that either woven or non-woven constructions may be utilized as can materials other than the polyester/polypropylene mix such as nylon, fiberglass and the like.

As indicated, in the preferred practice the polymer application unit 175 applies a deposit of a polymer 179 on the top of the cushion or foam layer 178 (FIGS. 5, 5A) after which the height of the polymer layer is doctored to a desired level. In the preferred practice, the polymer applied is a polyurethane-forming composition based on a so-called soft segment

pre-polymer of MDI (diphenylmethane diisocyanate) or an MDI derivative. The polyurethane-forming composition also preferably incorporates a silicone surfactant to improve both the frothability and stability of the polyurethane layer or "puddle" which is spread across the surface of the preformed foam layer 178.

The foam density of the preformed foam layer 178 is preferably in the range of about 6 to about 20 lbs. per cubic foot with a thickness of about 0.04 to about 0.12 inches. According to one potentially preferred arrangement, the foam density is about 16 lbs. per cubic foot or less with a thickness of about 0.06 inches although it is contemplated that such levels may vary greatly depending upon desired product characteristics.

It is contemplated that the material forming the preformed foam or rebond cushion 178 may be the subject of a broad range of alternatives. By way of example only and not limitation, at least four options or examples of the foam cushion material are believed to be viable to yield commercially acceptable foam products using virgin polyurethane and recycled polyurethane chips, chunks, granules, etc.

1) Use of standard filled Polyurethane system as the virgin and/or rebond polyurethane. One polyurethane foam contains 110 parts of filler and is applied at a density of about 15 lbs/cu. ft. If the thickness is in the range of .04 - .12 and we determine polymer weight only, using the density and filler levels above, the weight range of the polymer would be 4.32 oz/sq yd to 12.96 oz/sq yd.

2) A second option which would also work for the virgin and/or rebond polyurethane would be to increase the filler levels to 190 and reduce the density to 13 lbs/cu. ft. At the same thickness limits the polymer weights would then be 2.72 – 8.24 oz/sq. yd.

3) A third option for the virgin and/or rebond polyurethane would be to use an unfilled polyurethane (Prime urethane) system. High densities such as above are not possible with prime however, they perform because of the wall structure and the fact that no filler is present. If we consider a prime to be at 6 lbs/cu. ft. applied at the thickness limits above the polymer weight would be 2.88 – 8.64 oz/sq. yd.

4) A fourth option for the virgin and/or rebond polyurethane is also possible. Textile Rubber has a polyurethane system available under the trade designation KANGAHIDE which has only 15 parts of a filler material and is applied at 6 – 9 lbs/cu. ft. density, if a polymer calculation is again made at the described thickness limits it would be 4.3 – 13.02 oz/sq. yd.

Although the above examples have to do with polyurethane, a water based foam system can also be used.

A potentially preferred polyurethane-forming composition for use as the polymer 179 and the virgin and/or rebond polyurethane in the rebond foam 178 of the present invention is disclosed in U.S. Pat. No. 5,104,693 to Jenkines the teachings of which are incorporated herein by reference. Specifically, the preferred polyurethane-forming composition which is

used as the virgin and/or rebond polyurethane in the rebond and/or which is applied across the surface of the foam layer 178 includes:

A. At least one isocyanate-reactive material having an average equivalent weight of about 1000 to about 5000;

B. An effective amount of blowing agent; and

C. A polyisocyanate in an amount to provide an isocyanate index of between about 90 and about 130, wherein at least 30 percent by weight of such polyisocyanate is a soft segment pre-polymer reaction product of a stoichiometric excess of diphenylmethane diisocyanate (MDI) or a derivative thereof and an isocyanate-reactive organic polymer having an equivalent weight of from about 500 to about 5,000 and wherein the prepolymer has an NCO content of about 10 to about 30 percent by weight.

The polyurethane-forming composition also preferably contains a silicone surfactant to improve frothability and stability in the form of an Organo-silicone polymer such as are disclosed generally in U.S. Pat. No. 4,022,941 to Prokai et al. the teachings of which are incorporated herein by reference. Specifically, the preferred surfactant is preferably a linear siloxane-polyoxyalkylene (AB) block copolymer and specifically a polyalkyleneoxidemethylsiloxane copolymer. One such silicone surfactant which is particularly useful is available under the trade designation L-5614 from OSI Specialties,

Inc. whose business address is believed to be 6525 Corners Parkway, Suite 311, Norcross, Ga. 30092.

A sufficient level of the silicone surfactant is used to stabilize the cells of the foaming reaction mixture until curing occurs to allow the preliminary composite 166 to be laid into the uncured polyurethane-forming composition puddle without destabilizing the layer of such polyurethane-forming composition disposed across the surface of the foam layer 178. In general, the silicone surfactants are preferably used in amounts ranging from about 0.01 to about 2 parts per hundred parts by weight of component (A) and more preferably from about 0.35 parts to about 1.0 parts by weight of component (A) and most preferably from about 0.4 to 0.75 parts per hundred parts by weight of component (A).

As previously indicated, after disposition of the polyurethane-forming polymer 179 across the foam layer 178 the layer or "puddle" of the polymer deposited is preferably doctored to a pre-determined height by means of a doctor blade located at the polymer application unit 175. While a simple mechanical doctor blade is preferred, alternative equivalent means such as an air knife, spay coating, roller coating, or the like may also be used. Such an air knife is disclosed, for example, in U.S. Pat. No. 4,512,831 to Tillotson (incorporated by reference).

In one embodiment of the present invention, the intermediate composite 167 of the primary carpet fabric 112, which is preferably joined to the coated reinforcement material 158, can be laid directly into the polyurethane-forming composition 179 immediately after it

is doctored to the appropriate level without any need to significantly heat either the intermediate composite 167 or the polyurethane-forming composition 179. Accordingly, the intermediate composite 167 and the foam layer 178 with the applied polyurethane-forming composition 179 may be simultaneously delivered at room temperature to a mating roll 180 immediately following the application and doctoring of the polyurethane-forming composition. As will be appreciated, the use of rebond foam 178 reduces cost and produces a composite having a high recycled foam content. In the preferred process, at least one side of the intermediate composite 167 may be slightly preheated to improve operating control during lamination and curing but such preheat is not essential to formation of the desired product.

In the illustrated embodiment of the in line or in-situ carpet construction, the process described above results in the adhesive material 160 being laid adjacent to and extending away from the layer of cushioning foam 178 to the underside of the primary carpet fabric 112 with the layer of reinforcement material being embedded in intimate relation within the adhesive material 160 at a location intermediate the cushioning foam and the primary carpet fabric 112. Thus, at least a portion of the adhesive material 160 extends away from either side of the reinforcement layer 158.

Once the intermediate composite 167 has been laid into the polyurethane-forming composition 179, the resulting final composite 168 may be heated in a heating unit 182 by means of conduction, radiant, or convection heaters as are well known in the art. Contact conduction heaters may be preferred. Such heating may be carried out at a temperature of between about 250°F and about 325°F for between about 2 minutes and 8 minutes.

Following the heat curing operation, the final cushioned carpet composite 168 that is formed may be passed over a unidirectional heat source 185 such as a plate heater or roll heater at about 400 degrees F to fuse any outstanding fibers on the backing material 170 into a sooth surface. The carpet composite 110A, 110B, 110C (FIGS. 3A-3C) that is formed will thereafter be rolled, cut, sliced, or the like. When making carpet tiles, it is preferred that it be cut into carpet tiles almost immediately (rather than rolled) to avoid any undesired cupping or curl. After the carpet tiles are cut from the composite 168, they are printed, dyed, stacked, packaged, shipped to the customer, and/or stored.

It will be appreciated that a number of alternative practices may be incorporated into the present invention yielding a finished construction wherein the reinforcement layer 158 is enclosed within the adhesive material 160. In accordance with another example of the present invention, the primary carpet 112 is a loop pile tufted carpet formed by tufting, for example, a non-heatset yarn through the primary backing, then washing, steaming, drying, and injection or jet dying thereon a, preferably, monolithic or orientation independent design, color, or pattern to form, for example, a 12 foot wide primary carpet precursor of loop pile 120 and primary backing 122. By using a non-heatset yarn, and originally tufting the yarn at a rather long loop length, the washing, steaming, drying, and dying steps shrink the yarn to form smaller, tighter loops and provide a denser surface to the primary carpet precursor. Next, this primary carpet precursor is split in half and rolled to form, two separate six foot wide rolls 115 of split primary carpet precursor 113 (FIG. 5A).

Next, one roll 115 of the split primary carpet precursor 113 is used as the initial carpet feed in the apparatus of Figure 5A. A latex pre-coat or hot melt adhesive coat 124 is added to the back of the primary carpet precursor 113 to form a primary carpet fabric 112 in the upper run of the apparatus of FIG. 5A downstream of the accumulator 150 and upstream of the reinforcement bonding unit 155. For example, a thin layer of latex pre-coat 119 is applied to the back of the primary carpet precursor 113 using a coating roller 117. The remainder of the process proceeds as described above in relation to FIG. 5.

In accordance with yet another potential practice and as shown in FIG. 5B, it is contemplated that the cushioning foam or rebond foam 178 may be delivered in a preformed condition to the mating roll 180 for bonding to the intermediate composite 167 which may be formed as previously described in relation to FIGS. 5 and 5A. As will be appreciated, such a preformed cushioning foam 178 may be formed with the desired backing material 170 or multi-component backing composite (FIGS. 10A-C and 13A-C) disposed across its underside. Also, the upper surface of the preformed foam layer 178 may be heated by, for example, heater 195 and flame 196 to heat or melt the upper surface and enhance the attachment of composite 167 to foam layer 178.

Further, roll applicator 179 of FIG. 5B may be eliminated and heater 195 and flame 196 can be used to cause the foam layer 178 to adhere to the reinforcement material 158 of composite 166.

Similarly, the roll applicators 179 of FIGS. 5 and 5A may be eliminated and the composite 166 may be joined to the foam layer 178 by the adhesive or polymer 179.

It is contemplated that the apparatus of the present invention may include the entire assembly process from tufting the yarn in the primary backing, dying the tufted yarn, latex pre-coating the back of the primary backing, hot-melt coating the fiberglass reinforcing material, forming the cushion foam or rebond foam with or without the felt secondary backing, laminating the primary carpet, reinforcing fiberglass, and foam or rebond cushioning layer, heating or curing the laminate, and cutting the resultant carpet composite into carpet tiles, runners, area rugs, or the like, dying or printing the cut tiles, and packaging the resulting products. Also, it is contemplated that in accordance with the present invention the process may be broken down into its respective steps and done in a batch rather than a continuous mode. For example, the primary carpet may be formed in one operation and placed on rolls or folded into bins. The cushion backing or rebond foam layer may be formed in a separate operation and placed on rolls or folded into bins. The two preformed primary carpet and cushion backing materials may be joined by a mating unit using an adhesive, hot melt, hot melt with reinforcing layer, or the like. Also, the hot melt and reinforcing material composite may be preformed and placed on rolls or folded into bins. Still further, the preliminary composite 166, intermediate composite 167, or final composite 168 (FIGS. 5, 5A. 5B) may be preformed and placed on rolls or folded into bins.

As will be appreciated, there exist a substantial number of alternative embodiments and configurations for carpeting or carpet tile that may incorporate features of the present invention. As illustrated in FIGS. 6A and 6B, wherein like components to those previously described are designated by corresponding reference numerals within a 600 series, it is

contemplated that tufted loop pile and tufted cut pile constructions 610A and 610B include a first layer of hot melt adhesive 660 which extends away from the primary backing 622 and into contact with a sheet of reinforcement material 658 such as the non-woven glass or scrim material previously described. Thus, the first layer of hot melt adhesive 660 serves the function of securing the tufts 620, 621 in place relative to the primary backing 622 thereby avoiding the need to utilize a separate latex pre-coat. A second layer of hot melt adhesive 660 extends away from the reinforcement material 658 into contacting relation with the foam cushion or rebond material 678 to establish a bonding relation between the primary carpet 612 and the foam cushion or rebond material 678. Accordingly, a single adhesive layer extends between the upper surface of the reinforcement material 658 and the underside of the primary backing 622. By way of example only and not limitation, it is contemplated that such a construction may be realized as shown in FIG. 5 or by eliminating the latex pre-coat 119 in FIG. 5A, but otherwise carrying out the operation in the manner as previously described.

As illustrated in FIGS. 7A, 7B and 7C wherein like components to those previously described are designated by corresponding reference numerals within a 700 series, it is contemplated that tufted loop pile construction 710A, tufted cut pile construction 710B, and bonded cut pile construction 710C include first layer of resilient adhesive 760 extending away from the upper surface of a layer of reinforcement material 758 and which may be of a different character from a second layer of resilient adhesive 760' extending away from the lower surface of the reinforcement material. In all other respects, the configuration is substantially as illustrated and described in relation to FIGS 3A, 3B and 3C or 6A and 6B with assembly being carried out by any of the techniques illustrated and

previously described in relation to FIGS. 2, 4 and 5A-C. By way of example only and not limitation, in the event that the reinforcement material 758 is disposed between two different adhesives, it is contemplated that the adhesive 760 extending away from the upper surface of the reinforcement material 758 may be, for example, hotmelt, while the adhesive 760' extending away from the lower surface of the reinforcement material 758 may be, for example, polyurethane forming composition. Also, adhesive 760 of FIGS. 7A and 7B may be multiple layers of the same adhesive.

In FIGS. 8A and 8B wherein like components to those previously described are designated by corresponding reference numerals within an 800 series, there are illustrated yet additional potential embodiments of the present invention. In such embodiments, tufted loop pile construction 810A and tufted cut pile construction 810B include a layer of reinforcement material 858 disposed between a first layer of latex 824 extending away from the upper side of the reinforcement material 858 and a second layer of latex 824 extending away from the lower side of the reinforcement material 858. Thus, latex extends substantially between the upper surface of the foam cushion or rebond foam 878 and the primary backing 822 with the layer of reinforcement material 858 disposed within such latex at an intermediate position. Such latex is preferably a carboxilated styrene butadiene rubber (SBR) latex. Of course it is also contemplated that similar constructions utilizing non-latex adhesives such as Polyvinyl Chloride (PVC), ethylene vinyl acetate (EVA), and acrylics as well as hot melts as previously described may be useful.

As previously indicated, it is contemplated that additional stability may be applied to the construction of the present invention by incorporating stabilizing elements in intimate relation to the primary backing of a tufted primary carpet. Exemplary embodiments incorporating such configuration are illustrated in FIGS. 9A and 9B wherein like components to those previously described are designated by corresponding reference numerals within a 900 series. As illustrated therein, tufted loop pile construction 910A and tufted cut pile construction 910B include pile forming yarns 920, 921 tufted through a primary backing 922 which incorporates therein a non-woven or scrim primary backing stabilizing layer 923. The primary backing stabilizing layer 923 may be adjoined to the primary backing 922 by a needling or calendering operation. In addition, point bonding may be achieved between the structures by incorporating heat activated adhesive fibers within the non-woven construction. In the event that a construction incorporating a primary backing stabilizing layer is utilized, it is contemplated that the pre-coat 924 and/or the reinforcement material 958 may be substantially reduced or even eliminated entirely if desired due to the stability imparted to the primary backing 922, 923.

In FIGS. 10A-C there are illustrated several potential embodiments 1010A, 1010B, 1010C wherein like components to those previously described are designated by corresponding reference numerals within a 1000 series. As will be appreciated, such embodiments correspond substantially to those illustrated and described in relation to FIGS. 3A-C with the exception that the backing material 1070 is not in direct contacting relation to the foam cushion or rebond foam 1078. Rather a multi-component composite backing is applied across the underside of the foam cushion 1078. According to the relatively simple embodiment illustrated, such composite backing 1070, 1071 includes a relatively thin layer

of hot melt or other resilient adhesive 1071 extending in bonding relation between the underside of the foam cushion 1078 and the backing material 1070 of woven or non-woven construction as previously described. The thickness of such hot melt or other resilient adhesive is preferably not greater than about 40 oz/yd^2 and will most preferably be about 20 oz/yd^2 or less. As will be appreciated, it is contemplated that the multi-component composite may include virtually any number of layers of different materials including by way of example only and not limitation, release layers, additional adhesive layers, and/or stabilizing layers in various arrangements as may be deemed useful. Moreover, while the multi-component composite backing has been illustrated in relation to carpet constructions substantially corresponding to those illustrated and described in FIGS. 3A-C it is to be understood that such composite backings may likewise be used in any number of other constructions including, for example, those of FIGS. 6A-B, 7A-C, 8A-B, or 9A-B, but not limited to those previously described hereinabove.

Yet another set of alternative configurations are illustrated in FIGS. 11A-C wherein like components to those previously described are designated by corresponding reference numerals within an 1100 series. As illustrated, these embodiments 1110A, 1110B, 1110C correspond substantially with those of FIGS. 3A-C except that the foam cushion or rebond foam 1178 is substantially free of any supplemental backing. As will be appreciated, while the absence of a supplemental backing has been illustrated in relation to carpet constructions substantially corresponding to those illustrated and described in FIGS. 3A-C it is to be understood that such practices may likewise be used in any number of other constructions including, for example, FIGS. 6A-B, 7A-C, 8A-B, 9A-B, or 10A-C but not limited to those previously described.

In FIGS. 12A-C there are illustrated several potential embodiments wherein like components to those previously described are designated by corresponding reference numerals within a 1200 series. As will be appreciated, such embodiments 1210A, 1210B, 1210C correspond substantially to those illustrated and described in relation to FIGS. 3A-C with the exception that the backing material 1270 includes a thin layer of tacky releasable adhesive 1287 disposed across the undersurface. A thin access layer 1289 of paper or other suitable material is disposed in peel-away relation below the releasable adhesive so as to permit an installer to expose the releasable adhesive during installation. As will be appreciated, such releasable adhesive provides a relatively weak bond in tension while providing a stronger bond in shear such that a carpet element such as a carpet tile can be pulled away from an underlying surface but will be substantially resistant to undesired sliding movement. The thickness of such releasable adhesive is preferably not greater than about 20 oz/yd^2 and will most preferably be about 5 oz/yd^2 or less.

As will be appreciated, while the releasable adhesive backing has been illustrated in relation to carpet constructions substantially corresponding to those illustrated and described in FIGS. 3A-C it is to be understood that adhesive backings may likewise be used in any number of other constructions including but not limited to the constructions having bare foam undersides in FIGS. 11A-C.

As shown in FIGS. 13A-C wherein like components to those previously described are designated by corresponding reference numerals within a 1300 series, it is contemplated that carpet constructions 1310A, 1310B, 1310C include a releasable adhesive backing 1387, and layer 1389 may be incorporated as the lower surface elements of a multi-component composite backing 1370, 1371 as previously described in relation to FIGS. 10A-C.

Alternative examples of a tufted carpet product 1400 is illustrated in FIG. 14A and of a bonded carpet product 1410 is illustrated in FIG. 14B.

In the tufted carpet of Figure 14A, a primary carpet fabric 1412 is embedded in an adhesive layer 1416 in which is embedded a layer of glass scrim 1418. A rebond foam base composite 1419 is likewise adhesively bonded to the adhesive layer 1416. In the tufted carpet illustrated in FIG. 14A, the primary carpet fabric 1412 includes a loop pile layer 1420 tufted through a primary backing 1422 by a conventional tufting process and held in place by a pre-coat backing layer of latex 1424 or other appropriate adhesives including a hot melt adhesive or the like. The rebond foam base composite 1419 of the tufted carpet product 1400 includes a backing layer 1426 molded to a layer of urethane rebond foam 1428 as illustrated.

The bonded carpet product 1410 (FIG. 14B) employs the same type of rebond foam base composite 1419 adhesively bonded by adhesive laminate layers 1416. However, the primary bonded carpet fabric 1412 has somewhat different components from that of the tufted product in that it has cut pile yarns 1434 implanted in a PVC, latex, or hot melt

adhesive 1436 having a glass scrim reinforcement layer 1438.

In the bonded carpet of the present invention (FIG. 15B), the primary carpet fabric 1512 preferably comprises a plurality of cut pile yarns 1534 implanted in a latex or hot melt adhesive 1536 which is laminated to a glass scrim reinforcement or substrate layer 1538. It is contemplated that this substrate layer 1538 may be pre-coated with latex or other thermoplastic polymers to permit melting adhesion with the cut pile yarns 1534 upon the application of heat, thereby potentially reducing or eliminating the need for the latex or hot melt adhesive 1536.

An adhesive 1560 (FIGS. 15A, 15B) such as a hot melt adhesive is preferably applied to the reinforcement material 1558 by means of a film coater or other such unit as are well known. The reinforcement material 1558 and the primary carpet fabric 1512 are thereafter preferably passed in mating relation between joining members thereby bonding the reinforcement material 1558 to the underside of the primary carpet fabric 1512.

In the illustrated embodiment of FIGS. 15A, 15B, the layer of reinforcement material 1558 is adjacent to and at least partially embedded in the layer of rebond polyurethane 1578. That is, the reinforcement material 1558 is in intimate contact with the polyurethane 1578 such that the polymer material will hold the reinforcement in place.

It will be appreciated that a number of alternative practices may be incorporated into the present invention yielding slightly different products. By way of example only, the reinforcement material may be left completely out of the process thereby making the use

of the adhesive application apparatus and adhesive completely unnecessary. In such instances, the primary carpet fabric may be laid adjacent the rebond cushion thereby yielding a composite structure as illustrated in FIGS. 16A and 16B with the polyurethane rebond 1678 immediately adjacent to the primary carpet fabric 1612 (FIGS. 26 and 27).

In accordance with another embodiment, a hot melt layer may be used to mate the primary carpet to the cushion layer with or without the reinforcement material (FIGS. 19A, 19B, 22, 23, 24, 25).

In yet another potential alternative, the cushion backing may have an adhesive quick release backing attached to the face to which the polyurethane-forming composition is not applied. Moreover, it is contemplated that in some instances the backing might be completely eliminated such that the polyurethane rebond cushion would directly contact the flooring (FIGS. 25, 26, 27) as disclosed in relation to U.S. Pat. No. 4,286,003 which is incorporated herein by reference. Also, an adhesive-free carpet and method is described for example in U. S. Patent Application Serial No. 09/513,020, filed February 25, 2000, and entitled Adhesive-Free Carpet Tiles and Carpet Tile Installations (hereby incorporated by reference herein).

Although it is preferred for the tufted modular carpet or modular carpet tile of the present invention to have the following layers: yarn, primary backing, latex pre-coat adhesive, hot melt adhesive, fiberglass, rebond foam, and felt (FIG. 14A), it is contemplated that one or more of these layers may be eliminated or substituted for and still provide a carpet or tile having the desired properties or characteristics. For example, the latex pre-coat adhesive

layer may be replaced by a bitumen hot melt layer (FIG. 20), the felt layer may be eliminated on a free lay (no floor adhesive) installation product (FIGS. 25, 26, 27), the glass layer may be eliminated (FIG. 21, 26), or the like.

A potentially preferred configuration for a resulting tufted carpet composite is illustrated in FIG. 17A. As illustrated, the reinforcement material 1758 will be at least partially surrounded by, and embedded in, the polyurethane 1778. As illustrated, it is contemplated that the layer of pre-coat may be eliminated in the tufted structure since the tufts may be held in place by the polyurethane 1778. A potentially preferred configuration for a resulting bonded carpet composite is shown in FIG. 17B. One or both layers 1778 may be rebond foam.

Another added feature of the present invention is that it incorporates rebond or recycled product and can be sold as such in the open market. Rebond is a process by which manufacturers receive waste polyurethane (typically furniture pad, waste generated through the manufacture of the virgin material, etc.), grind or chip the waste urethane into specific size chips, and then through a compression technique inject pure urethane and glue the chips back together the result of which is a large log of compressed urethane.

In accordance with the present invention, the urethane chips are a low density variety such as 1-3 lb/cu. ft. After the compression and gluing takes place, the density can be as high as 15 lb/cu. ft. or more. Then this log is cut similar to making ply wood into roll lengths of almost any thickness. Then the lengths of foam are taken to a flame laminator and the non-woven secondary and the glass is bonded to each side of the rebond cushion and

again rolled up. The only step required from this point is the lamination of this composite to the pre-coated tufted carpet or to use a hot melt adhesive and the result is a cushion tile using waste or recycled material.

For rebond carpet tile we have found that it is important to use as close a density and thickness as our other cushion back carpet tile as possible and also to decrease substantially the chip size. As chip size is decreased its much more attractive, stronger, and more uniform.

In accordance with one embodiment of the present invention, a preformed "rebond" foam, pad or underlayment is used to manufacture a commercial grade cushion carpet tile. A rebond pad of approximately 13 pounds/cubic foot density is modified to have a respective non-woven material bonded to each of the upper and lower surfaces thereof. The composite rebond pad has a thickness of approximately .25" and is slit in half, producing two foam backings, each approximately .125" thick with a non-woven material attached to one surface. Next, the slit pad is directly bonded using a hotmelt adhesive to either pre-coated tufted carpet or latex based bonded carpet and then cut into tiles.

There are several additional alternative ways of laminating the fabric to the rebond in the composite of the present invention. Such as:

1. Non-woven and/or glass can be first bonded to the rebond (since it is urethane) by flame lamination and then this composite is laminated to the carpet by use of an adhesive. This adhesive can be hotmelt of many natures or it can also be a urethane either reactive or water based.

2. These composites can also be laminated using an adhesive film.

3. These composites can be laminated to the rebond by use of urethanes, water based adhesives or hotmelts. This lamination can either occur off-line to form the composite or they can occur as an in-line operation as the carpet is laminated to the composite.

As well as other ways of laminating fabric to urethane foam, for example, using light reactive materials.

The following table represents exemplary embodiments of the constructions or products of the present invention.

Examples of Rebond cushion modular carpet

	Bonded cut pile	Bonded cut pile	Tufted loop pile	Tufted cut pile	Tufted cut pile	Tufted cut pile	Bonded cut pile
Yarn type	Spun	Spun	filament	filament	spun	filament	Spun
# plies	2	3	3	2	2	2	1
Yarn weight	28 oz / yd2	28 oz / yd2	24 ox / yd2	40 oz / yd2	40 oz / yd2	20 0z / yd2	20 ox / yd2
Fibre type	Nylon 6,6	Nylon 6,6	Nylon 6,6	Nylon 6,6	80/20 wool/nylon	Nylon 6,6	Nylon 6,6
Dye method	stock dye	stock dye	space dye	Millitron	Millitron	soluton dye/Millitron	stock dye
fabric method	bonded	bonded	tufted loop	tufted cutpile	tufted cutpile	tufted cutpile	bonded
primary backing	glass scrim	glass scrim	polyester spunbonded	polyester spunbonded	polyester spunbonded	polyester spunbonded	glass scrim
latex type	EVA	EVA	EVA	EVA	EVA	SBR	EVA
latex weight	15 oz / yd2	15 oz / yd2	15 oz / yd2	15 oz / yd2	15 oz / yd2	15 oz / yd2	15 oz / yd2
tiecoat adhesive	filled hot melt	filled hot melt	filled hot melt	filled hot melt	filled hot melt	filled hot melt	filled hot melt
tiecoat weight	40 oz / yd2	40 oz / yd2	40 oz / yd2	40 oz / yd2	40 oz / yd2	40 oz / yd2	40 oz / yd2
glass tissue	1.3 oz / yd2	1.3 oz / yd2	1.3 oz / yd2	1.3 oz / yd2	1.3 oz / yd2	1.3 oz / yd2	1.3 oz / yd2
cushion layer	rebond p/u	rebond p/u	rebond p/u	rebond p/u	rebond p/u	rebond p/u	rebond p/u
density	10 # / ft3	10 # / ft3	10 # / ft3	10 # / ft3	10 # / ft3	10 # / ft3	10 # / ft3
thickness	4 mm	4 mm	4 mm	4 mm	4 mm	4 mm	4 mm
felt type	polyester nonwoven	polyester nonwoven	pe/pp nonwoven	pe/pp nonwoven	pe/pp nonwoven	pe/pp nonwoven	polyester nonwoven
felt weight	3 oz / yd2	3 oz / yd2	3 oz / yd2	3 oz / yd2	3 oz / yd2	3 oz / yd2	3 oz / yd2
lamination method :							
felt/foam/glass	flame	flame	flame	flame	flame	flame	flame
carpet / backing	hot melt	hot melt	hot melt	hot melt	hot melt	hot melt	hot melt

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	Tufted loop pile	Tufted loop pile	Alternatives applicable to all examples
Yarn type	filament	filament	
# plies	1	3	
Yarn weight	15 oz / yd2	22 oz / yd2	
Fibre type	Nylon 6	Nylon 6,6	Nylon 6; polypropylene
Dye method	space dye	piece dye	Hank dye
fabric method	tufted loop	tufted loop	
primary backing	polyester spunbonded	polyester spunbonded	woven polyplopylene
latex type	EVA	EVA	SBR; Acrylic
latex weight	15 oz / yd2	15 oz / yd2	6-25 oz/yd2
tiecoat adhesive	filled hot melt	filled hot melt	
tiecoat weight	40 oz / yd2	40 oz / yd2	20-50oz/yd2
glass tissue	1.3 oz / yd2	1.3 oz / yd2	1-3 oz/yd2
cushion layer	rebond p/u	rebond p/u	
density	10 # / ft3	10 # / ft3	6-12 #/ft3
thickness	4 mm	4 mm	1.5-10mm
felt type	pe/pp nonwoven	pe/pp nonwoven	pp nonwoven
felt weight	3 oz / yd2	3 oz / yd2	2-5 oz / yd2
lamination method :			
felt/foam/glass	flame	flame	Hot melt
carpet / backing	hot melt	hot melt	

As will be appreciated, the carpet construction of the present invention may take on any number of other constructions aside from those that have been particularly illustrated and described. By way of example only, the carpet construction of the present invention may take on the configuration as disclosed in co-pending U. S. Patent Application Serial No. 09/513,020, filed February 25, 2000, and entitled Adhesive-Free Carpet Tiles and Carpet Tile Installations (hereby incorporated by reference herein). It is, of course, to be appreciated that while several potentially preferred embodiments, procedures and practices have been shown and described, the invention is in no way to be limited thereto, since modifications may be made and other embodiments of the principles of this invention will occur to those skilled in the art to which this invention pertains. Therefore, it is contemplated by the appended claims to cover any such modifications and other embodiments as may incorporate the features of this invention within the true spirit and scope thereof.